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SECOND REPORT

National Steering Committee for Application of Pesticides - Vegetation Management

May 11, 1990

USDA Forest Service
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CONTENTS

I. INTRODUCTION

The second meeting of the National Steering Committee for Aerial Application of Pesticides - Vegetation Management met in West Sacramento, California, on March 7-8, 1990.

A. Committee Members

Phil Aune	PSW/TMR	(Redding, CA)
Garth Baxter	R-4/WO	(Ogden, UT)
Ken Bentson	PNW	(Portland, OR)
Robert Campbell*	FPMI	(Sault Ste. Marie, Ontario)
M. Boyd Edwards*	SE/TMR	(Dry Branch, GA)
Larry Gross	WO/FPM	(Washington, DC)
Ellis Huddleston	New Mexico State University	(Las Cruces, NM)
Paul Mistretta	R-8/RO	(Atlanta, GA)
Ed Monnig*	R-1/FPM	(Missoula, MT)
Max Ollieu	WO/FPM	(Washington, DC)
Donald Perala	NC/TMR	(Grand Rapids, MI)
Michael Rutty	Stanislaus NF	(Sonora, CA)
Fay Shon	R-6/RO	(Portland, OR)
Larry Yarger*	NA/FPM	(Milwaukee, WI)
Jack Barry (Chair)	WO/FPM	(Davis, CA)

Members names followed by an asterisk were not in attendance. Robert Campbell, FPMI, was unable to attend due to foreign travel restrictions.

B. Committee Objectives

The objective of the USDA Forest Service (FS) National Steering Committee for Application of Pesticides - Vegetation Management is to review the needs and recommend pilot project and field testing of herbicides. The committee's charter was expanded in 1989 to include ground application.

C. Operating Guidelines

Operating guidelines, generic to the four FPM national steering committees, are enclosed in **(Appendix A)**.

II. RECOMMENDATIONS

Recommendations for national attention are ranked by priority with one being the highest priority. The committee also recommends the staff and in some cases names a staff person to initiate the recommended action. The staff or person may choose to delegate the action to other organizational elements, staff persons, or to contractors.

A. Administration

1. Broaden charter of this committee to include all methods of vegetation management and review geographic representation on the committee in view of expanded charter; and change committee title to "National Steering Committee For Managing Vegetation on Forest and Range Lands".

   Priority 1 - Chief

2. Involve R-3 as a partner with R-4 in developing a risk assessment for all herbicides registered for forest and range use.

   Priority 1 - Chief

3. Lift the deferral on aerial application of herbicide.

   Priority 1 - Chief

4. Identify Forest Health as a priority research program.

   Priority 1 - Chief

5. Develop a program or initiative to inform the public on how the Forest Service manages national forest and range lands. The program would include vegetation management. The audience would include general public, to include students of all grades; state and private cooperators; and other Federal agencies.

   Priority 2 - Chief

6. Clarify relationship of Forest Service and State pesticide certification program.

   Priority 2 - WO/FPM

7. Evaluate opportunities to cooperate with New Mexico State University in spray technology, vegetation management, and biodiversity and ecosystem system impact research.

   Priority 3 - WO/FPM

B. Training and Technology Transfer

1. Analyze national, regional, and area needs for herbicide-use training to include safety, material safety data sheets, State requirements, certification training, treatment prescriptions, and theory vs practice.

   Priority 1 - WO/FPM & TM
   Regions
   NA

2. Encourage Forest Service support and participation of the Western Regional Coordinating Committee (WRCC-51) and Southern Regional Information Exchange Group on Pesticide Application Technology (SRIEG No. 29).

   Priority 2 - WO/FPM

C. Cost Benefit Information and Decision Support Systems

1. Develop a decision support system for vegetation management prescriptions.

   Priority 1 - WO/TM

2. Develop a national economic threshold model or model shell.

   Priority 2 - WO/TM

3. Develop a national system to monitor vegetation management projects at the forest level, from planning, to treatment, to achievement of the desired result (e.g. tree crown closure).

   R-6/FPM

D. Environmental and Safety Needs

1. Develop in cooperation with the Regions a computerized national risk assessment program.

   Priority 1 - WO/FPM

2. Develop a national system to gather worker safety information for non-chemical methods of vegetation management.

   Priority 1 - WO/FPM

3. Develop a system to collect, catalogue, and retrieve environmental fate data.

   Priority 1 - WO/FPM

4. Support forestry worker exposure and safe work method studies, through NAPIAP, special project, and program funds.

   Priority 1 - WO/FPM

E. Biodiversity and Ecosystem Impact

1. Develop a national policy on biodiversity, to include defining biodiversity, identifying WO staff responsibilities, and developing a national action plan.

   Priority 1 - Chief

2. Support and initiate long-term studies (5-20 years) to monitor various vegetation management alternatives in the Lake States, Southwest, and Southeast.
   Priority 1 - WO/FPM

3. Incorporate biodiversity in the PSW, R&D program and other applicable R&D programs.
   Priority 1 - Research

4. Establish and maintain a bibliography and library of information (published papers, reports, "fugitive" literature, etc.) on vegetation management research and control projects.
   Priority 1 - WO/FPM

F. Application Technology and Equipment

1. Evaluate use of the FSCBG and AGDISP aerial spray models for ground applications.
   Priority 1 - WO/FPM

2. Review and update as appropriate the WO/Engineering (MTDC) publications: Catalogue Revegetation Equipment (Feb 1980) and Equipment For Reforestation and Timber Stand Improvement (Oct. 1980).
   Priority 2 - WO/Engr.

III. PROGRESS

A. Summary of Progress Related to Committee's 1989 Recommendations.

1. Administrative

   a. Director, WO/FPM and Director, WO/Policy and Analyses are developing a staff paper on role of FPM in vegetation management.

   b. Director WO/FPM updated the Chief on national deferral of aerial application of herbicides.

   c. PSW has drafted a Memorandum of Understanding for vegetation management research cooperation with Canadian Forestry Service's Forest Pest Management Institute (FPMI).

   d. WO-FPM has drafted an MOU for pest management cooperation with FPMI.

   e. A committee membership was extended and accepted by FPMI.

f. This committee is helping to focus attention among staffs (NFS, S&PF, and Research) on vegetation needs and issues.

2. **Training and Technology Transfer**

Pesticide-use training has been conducted by R-1, R-4, R-5, and R-8. Additionally WO/FPM conducted a national pesticide - use management course at Marana, Arizona.

3. **Decision Support Systems**

a. PSW is developing decision support systems for vegetation management.

b. R-6 is developing a decision making system.

4. **Environmental and Safety Needs**

a. NAPIAP has been encouraging and funding environmental fate studies.

b. WO/FPM is actively supporting re-registration of herbicides.

c. WO/FPM is supporting work to obtain risk assessment data on pesticides through NAPIAP.

d. WO/FPM is cooperating with the Society of Environmental Toxicology and Chemistry by supporting a platform session at their annual meeting (November 12-16, 1990). The session is Pesticides In Forest Management: Predicting and Observing Fate.

e. WO/FPM has membership on a national technical advisory committee sponsored by the National Agricultural Chemical Association (NACA). This committee provides technical recommendations to NACA on spray accountancy and drift studies to support pesticide registration and re-registration.

f. SO, PNW, and NC are conducting environmental fate studies of selected herbicides.

5. **Biodiversity and Ecosystem Impacts**

The committee noted the emergence of biodiversity as a leading national issue and projects that biodiversity will significantly influence vegetation management practices in the future.

6. **Application Technology and Equipment**

a. A project has been established at MTDC to investigate methods of plot marking and navigation systems for aircraft.

b. An intensive program was begun in 1989 to distribute two computer-based aerial spray models (FSCBG and AGDISP) to industry, academia, and governments. Concurrently an advisory committee and user groups were formed, and hands-on training has been given throughout the United States.

c. R-8 continues to take the lead in supporting training and use of hand-held herbicide application methods.

B. Committee Member Reports

Reports by committee members Phil Aune, Ken Bentson, Boyd Edwards, Paul Mistretta, Ed Monnig, Don Perala, Mike Rutty, Fay Shon, and Larry Yarger are enclosed in **Appendix B.**

IV. DISCUSSIONS AND OTHER NEEDS

This committee was established in 1988 to identify needs and to recommend field tests (experiments) and pilot tests of aerially applied herbicides. It became apparent at the 1989 committee meeting that aerial application could not be singled out as a national issue without comparable consideration being given to all other methods of vegetation management. It was, therefore, within this context, that the committee recommended that the charter of this committee be expanded to include all methods of managing vegetation on forest and range lands. Consistent with the expanded charter the committee recognizes the need to recruit others for membership who are nationally recognized specialists in vegetation management.

Other needs include efficacy data on specific herbicides for forest and range use to include plant stress data for timing application, and canopy penetration studies. Regional pesticide-use coordinators could coordinate projects with field users, industry, universities, and researchers. Specific R-5 needs that were discussed included: field evaluation of the Herbi sprayer for application of new herbicide formulations; procedures for sole-source contracting of "turn-key" applications (applicator + herbicide + applicator equipment); and determining aggregate cost of the NEPA process - appeals, project delays, and legal actions resulting associated with herbicide projects.

Some members expressed the need for better coordination and communication among entities conducting vegetation management research. After some discussion it became apparent that this need was, for the most part, being taken care of by various cooperatives, conferences, and committees. With the exception of the Weed Society of America, and other professional societies, most address local, state, or regional needs. The Forest Service does participate in these groups to the extent that their activities relate to forests and range; and use this media to exchange data and information with States, academia, industry, and other federal agencies. It, therefore, appears that the mechanism is in place for technical exchange of information and data.

Ellis Huddleston expressed the interest of New Mexico State University in forest pest management activities. These include pesticide-use training, economic analyses and cost/benefit studies, biodiversity, long-term study plots (forest and range), wind tunnel studies, and a large (section size) field test site.

I would like to take this opportunity to make a personal observation and call attention to a trip report by James H. Miller, of the Southern Forest Experiment Station, Auburn, Alabama, who visited China during April and May 1989 even though we did not discuss it at our steering committee meeting. An Executive Summary of his trip report is included as Appendix C. I suggest everyone with interests in vegetation management, who has not already done so, obtain a copy of James Miller's trip report. As I read the report, I became vividly aware that some land managers have few vegetation management options. Their land has been stripped of native vegetation, their soils sterile and eroded, and their harvests insufficient. While we focus on biodiversity, cultural pest management, and priority research programs, other countries are concerned about basic survival of people and forests. Therefore, while the Forest Service struggles over the use of herbicides, and rejects their use, other countries desperately need to use them and use them effectively for survival. Who will be supporting herbicide-use technology and who will take it to these countries? With our world forestry responsibilities I believe we have a responsibility to maintain our leadership in safe, efficient, and economic use of herbicides.

VI. SUMMARY

The National Steering Committee for Aerial Application of Pesticides - Vegetation Management met in West Sacramento, California on March 7-8, 1990. The committee membership was expanded to include Forest Pest Management Institute (Canada) and academia (New Mexico State University). The committee developed several recommendations; and reviewed and discussed accomplishments related to but not necessarily a result of the committees 1989 recommendations. The committee identified biodiversity a significant issue that will influence future vegetation management activities. The committee recommends that the committee charter be expanded to include all methods of managing vegetation on forest and range lands, and that its membership be expanded accordingly.

The next meeting of the committee has been tentatively scheduled to be held the week of September 24-26, 1990 at Corvallis, Oregon.

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APPENDIX A

OPERATING GUIDELINES
FOR
NATIONAL STEERING COMMITTEES
CONSIDERING
FIELD TESTS AND PILOT PROJECTS
FOR THE
AERIAL APPLICATION OF PESTICIDES

MEMBERSHIP: Committees members should be nationally recognized research, developmental, and applied scientists as well as natural resource professionals drawn for the most part from the Forest Service but also from other Federal and State agencies.

PURPOSE: The committees' primary tasks are to analyze, identify, and recommend field and pilot testing needs for aerial application of pesticides. Needs include those associated with pesticides, application systems, techniques, and strategies that influence the FS's and State cooperators ability to use pesticides safely, effectively, and in an economically, and environmentally acceptable manner.

PROCEDURES:

The committees shall:

- meet at least annually, preferably during late summer or early fall so recommended projects can be considered for approval, funding, and implementation the next field season.

- focus on sound science that may lead to improving pesticide application consistent with its stated purpose.

- assign priorities to testing needs agreed to by the committee.

- review data and progress of field and pilot tests.

- suggest who might conduct future tests and where the tests might be conducted.

- take action to address needs such as development of guidelines for field test and pilot projects, database formats, and literature studies.

- establish sub-committees to pursue single issues such as review of laboratory and field test data.

The members shall:

- determine pesticide application needs within their geographical, administrative or organizational area prior to each meeting.

- be cognizant of all appropriate Region/Area/Station/State/cooperator needs.

- bring to the meeting needs that have been discussed with line officers and staff.

- represent the unit's needs within the national perspective of the committee.

The Director FPM/WO shall:

- coordinate the report recommendations within WO, and with the Regions, NA, and Stations as appropriate.

- review the steering committee recommendations and resultant FPM project proposals for funding.

- give strong consideration to the steering committees recommendations in prioritizing project proposals for funding.

- complete project approval and funding by January for projects funded by FPM.

APPENDIX B
Phil Aune

CHARTER FOR A

VEGETATION MANAGEMENT ALTERNATIVES
FOR REGENERATION OF CALIFORNIA CONIFERS

RESEARCH AND DEVELOPMENT PROGRAM

Recommended:

Raymond G. — 4/16/87
Assistant Regional Forester, TM, R-5 — Date

Ronald E. Stewart — 4/17/87
Assistant Station Director, CR-NC, PSW — Date

Approved:

for Raymond G. — 4/16/87
Regional Forester, R-5 — Date

Roger R. Bay — 4/17/87
Station Director, PSW — Date

Concurred:

J. Lamar Beasley — 5/8/87
~~Deputy~~ Chief, NFS — Date

5/8/87
~~Deputy~~ Chief, Research — Date

Concurred:

for George M. Leonard — 5/11/87
Chief — Date

VEGETATION MANAGEMENT ALTERNATIVES
FOR REGENERATION OF CALIFORNIA CONIFERS
RESEARCH AND DEVELOPMENT PROGRAM

I. Justification

Reforestation of cutover lands in California is mandated by two principal laws: the National Forest Management Act (NFMA) of 1976 for the national forests and the California Forest Practices Act for private lands. Both laws require that all harvested forest lands be promptly reforested, following timber harvest, with desirable tree species at adequate levels of stocking. In addition, NFMA requires that the new stands achieve rates of growth necessary to meet Forest Land and Resource Management Plan objectives.

Reforestation is a major investment. For example, the Pacific Southwest Region of the USDA Forest Service currently plants 30,000 to 35,000 acres each year at an average cost of more than $500 per acre. The annual plantation establishment rate is expected to double within this decade as Forest Plans are implemented. Similar investments in reforestation are experienced by the many private forest land owners in the State.

Competition for limited soil moisture is a major cause of plantation failure during the dry Mediterranean summer in California. Competition for water and light with vegetation also reduces the growth rate and vigor of trees and makes the plantation more susceptible to losses from insects, diseases, and tree-damaging animals. Recent restrictions on use of key vegetation control practices, such as herbicides, prescribed fire, and mechanical clearing, may result in use of less effective or more costly alternatives and in failure of new plantations to meet stocking or stand growth requirements. For example, loss of herbicides and the absence of suitable substitutes could reduce the yield on 1.8 million acres of National Forest System lands by about 40 percent, or 400 million board feet per year.

Because of past reliance on herbicides, research and development of alternative vegetation control methods has lagged. Some efforts, such as the PSW/R-5 Administrative Study, "Comparing Manual and Chemical Release of Conifer Plantations", are underway. But such studies are limited in scope and need to be supplemented and integrated with work in other Research Work Units and conducted by cooperators. In addition to identification and development of new tools to control competing vegetation, information is needed on where and how much vegetation management is needed to assure economically-efficient treatments.

II. Mission and Objectives

The mission of this Research and Development (R&D) Program is to develop and evaluate alternative methods for preventing or controlling competing vegetation and to develop a vegetation management decision support system for use in reforestation and stand establishment of important California forest types.

Specific objectives of the Program include:

1. Develop and evaluate alternative vegetation management techniques, such as:

-alternative silvicultural systems (even- and uneven-aged management) and reforestation strategies (sequences of practices, natural and artificial regeneration) that minimize the development or influence of competing vegetation

-alternative vegetation control practices that are environmentally safe and economically efficient.

2. Develop a better understanding of the growth of competing vegetation and the competitive interactions of young conifers, shrubs, weed trees, and herbaceous species.

3. Develop a vegetation management decision support system that includes a small tree growth model incorporating the effects of competing vegetation, existing and proposed forest growth and yield simulators (CACTOS, PROGNOSIS, and ORGANON), effects and costs of alternative vegetation management approaches, and analysis of economic efficiency.

III. Program Organization, Staffing, and Participating Units

The staffing will consist of a Program Manager (GM-13/14) and business and clerical support. The position will be located in Redding at the Silviculture Laboratory. The Program Manager will report directly to the Station Director, PSW and the Station will provide statistical, editorial, and other scientific and administrative support. Broad policy, funding, staffing, and program direction is provided by a Board of Directors, composed of the Regional Forester for Region 5 and the Station Director for PSW.

Research Work Units PSW-4102, "Establishment and Maintenance of Regeneration for California Forests", and PSW-4101, "Silviculture of California Conifer Types," both located at Redding, will be directly assigned to the Program under the direction of the Program Manager. The Silviculture Development Unit (SDU) of Region 5, located at Redding, will have a major role in achieving the objectives of the Program, but will not be directly assigned to the Program Manager. Cooperating units (units that may be involved in individual studies or on a consultative basis) may include the National Forests and the Forest Pest Management Staff of Region 5, and RWU-PSW-4201 ("Range Management Research in California") and PSW-4202 ("Methods and Guidelines for Monitoring Wildlife Populations"), at Fresno; PSW-4251 ("Timber/Wildlife Habitat Interactions") and PSW-4351 (Processes Affecting Management of Pacific Coastal Forests on Unstable Lands"), at Arcata; PSW-4301 ("Environmental Hydrology of the California Snow Zone"), PSW-4501 ("Disease Pests of California Forests") and PSW-4502 ("Biology and Control of Insects Adversely Affecting Regeneration and Establishment of Western Forests"), at Berkeley; and PSW-4403 ("Site-Specific Fire Prescriptions for Chaparral and Related Ecosystems"), PSW-4451 ("The Ecology of Chaparral and Associated Ecosystems"), and PSW-4452 ("Fire Management Planning and Economics"), at Riverside. The Program Manager will coordinate work with cooperating units through normal line officers of the Region and Station, as developed and negotiated through annual plans of work.

[illegible] will be directly equal to [illegible]
[illegible] of the Program Managers. [illegible] located at Re[illegible]
[illegible] but with one [illegible]

The Program Manager, Research Work Units, and cooperating units may carry out the objectives of the Program through cooperative agreements with forest industry, State and other federal agencies, and universities.

The organizational structure of the Program is shown in Exhibit 1 and a list of potential cooperators is provided in Section VII. Cooperation and Coordination.

IV. Schedule of Work

The Program, with the assistance of PSW research work units, the SDU, management specialists of Region 5 and cooperating agencies, and universities, will carry out research and development activities related to completion of the Program objectives. Specific tasks will include:

1. Develop a plan of work to guide the research and development activities for the duration of the Program, by September 30, 1987. The plan will include 5- and 10-year milestones.

2. Develop an annual plan of work for all units, including cooperating units, by September 30 of each year for the following fiscal year. The plan is to include research, development, and demonstration activities.

3. Revise Research Work Unit Descriptions (RWUD's) as needed, by February 1, 1988.

4. Report Program progress and needs annually to the Board of Directors (continuing).

5. Establish and maintain coordination and support of the Program through internal and external contacts (continuing).

6. Disseminate results, findings, and products from the research and development activities in a timely manner (continuing).

7. Conduct a mid-term review of the program accomplishments and direction in FY 1992.

V. Program Duration and Funding

The "Vegetation Management Alternatives for Regeneration of California Conifers Research and Development Program" will have a duration of 10 years, beginning in FY 1987. Because of past and existing research, it is anticipated that important new products will be available within the first few years of the Program. For example, results of an "Administrative Study of Alternatives to Herbicides for Conifer Release" and a cooperative study to develop a first generation small tree growth model will be available by FY 1989. Much of the information needed to meet Program objectives for the Mixed Conifer forest type will be available by FY 1992. Comparable results for the Douglas-fir type will likely become available during the second five-year period of the Program.

The following funding is available in FY 1987:

	Source of funds	
	Research	NFS
	(thousands of dollars)	
Program Manager and support	$ 50	$ 50
RWU-PSW-4101	367	0
RWU-PSW-4102	411	0
Silviculture Development Unit	0	37
Total:	$ 828	$ 87

In addition, the small tree growth modeling effort is supported by the California Forest Research Association, composed of forest industry, federal, state, and university organizations, at $35,250 for FY 1987.

Based on planned harvest levels in the draft Forest Plans and upon expected vegetation management needs to meet plan goals, the following priorities for research have been established by forest and competing vegetation type: (1) Sierra Nevada mixed conifer/greenleaf manzanita; (2) Sierra Nevada mixed conifer/bearclover; (3) Douglas-fir/tanoak-madrone; (4) Douglas-fir/snowbrush ceanothus; and (5) red fir/lupine-grass. At current funding levels, the Program will concentrate on priorities (1) and (2) and opportunistically initiate key studies in the Douglas-fir/tanoak-madrone type. High costs for study establishment will be experienced during the first few years of the program. As studies in the Sierra Nevada mixed conifer type enter into a maintenance phase, funds will be rapidly shifted into additional research in the Douglas-fir type. This research should be more efficient since it will be based on experience gained in the mixed conifer type. Significant studies of alternative silvicultural systems for each of these forest types will occur only at higher levels of funding.

The first increment of additional funding will be used by the Program Manager as a discretionary fund for specific research and demonstration efforts by participating and cooperating units or university scientists that support Program objectives. A fund of not less than $50,000 nor more than $100,000 is desirable. New funds above this level will be used to accelerate research first in the Douglas-fir type and then in the red fir type.

VI. Environmental Impacts

Environmental considerations will be documented in individual study plans or project proposals. For studies and demonstrations established on National Forest lands, Program activities will ordinarily be included in timber sale/reforestation and individual project environmental assessments. Activities on private lands will meet requirements of the California Environmental Quality Act (CEQA).

VII. Cooperation and Coordination

Effective execution of the Program objectives will require cooperation and coordination with numerous interested agencies and groups. The Program Manager

will need to develop individual contacts and assure timely dissemination of information and involvement of interested parties. Organizations that will have interest in the Program include:

Forest Service
- Region 5 (Siskiyou and Rogue River National Forests)
- Region 6
- PNW Station

Other Federal Agencies
- USDI, Bureau of Land Management-Oregon

State Agencies
- California Department of Forestry and Fire Protection

Universities
- University of California at Berkeley
- University of California at Davis
- Humboldt State University
- Oregon State University

Forestry Associations and Companies
- California Forest Vegetation Management Conference
- California Forest Pest Control Action Council
- California Forest Protective Association
- California Forest Research Association
- Western Timber Association
- Santa Fe-Pacific Timber Company
- Fruit Growers Supply Company
- Michigan-California Lumber Company
- Sierra Pacific Lumber Company
- Roseburg Resources Company
- Collins Pine Company

Private Interest Groups
- Group for Organic Alternatives to Toxic Sprays (GOATS)
- Southern Oregon Citizens Against Toxic Sprays (SoCATS)

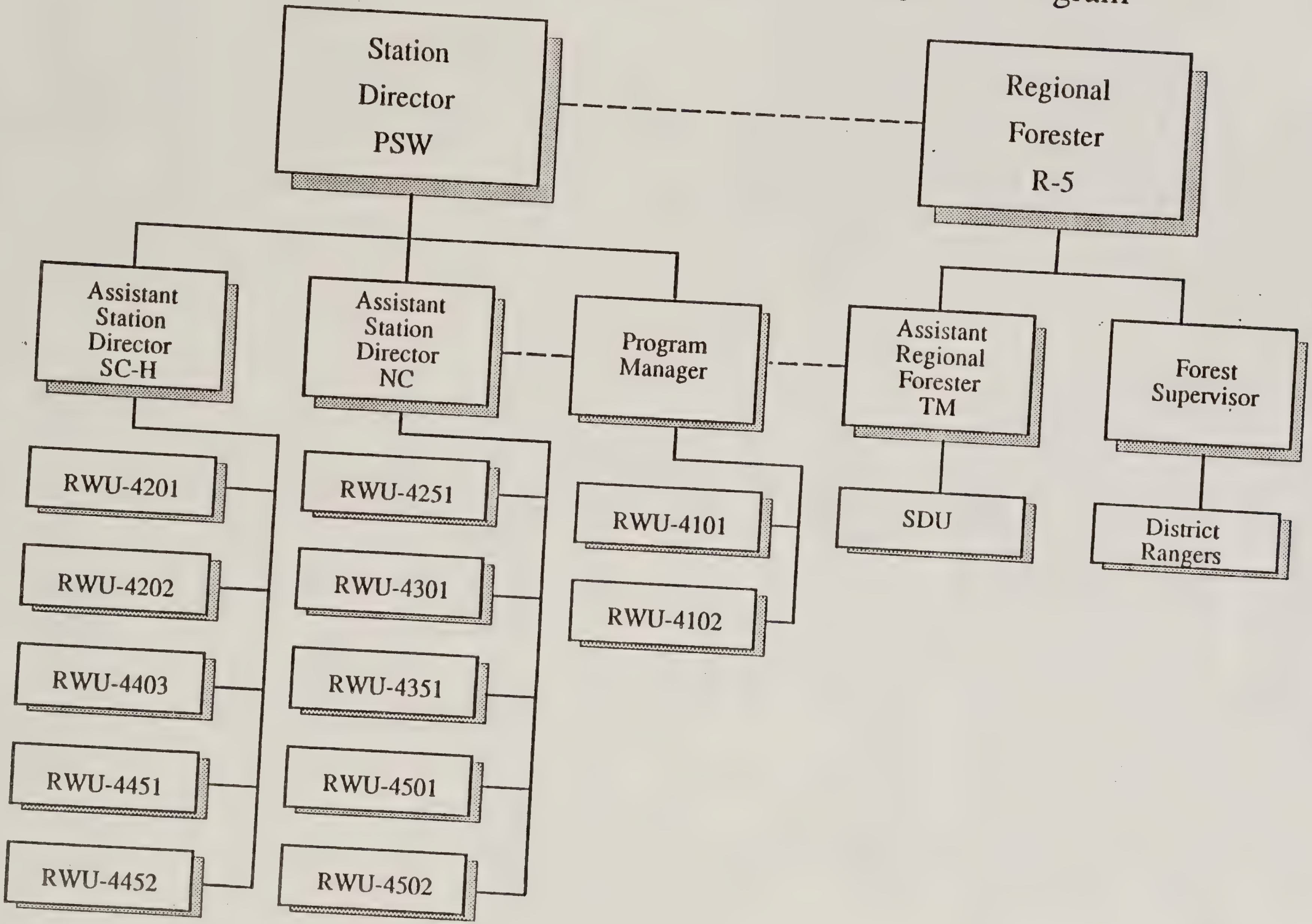
Exhibit 1

ORGANIZATION OF THE RESEARCH AND DEVELOPMENT PROGRAM

		Station Director PSW	Regional Forester R-5	
Assistant Station Director SC-H	Assistant Station Director NC	Program Manager	Assistant Regional Forester TM	Forest Supervisor
RWU-4201	RWU-4251	RWU-4101	SDU	District Rangers
RWU-4202	RWU-4301	RWU-4102		
RWU-4403	RWU-4351			
RWU-4451	RWU-4501			
RWU-4452	RWU-4502			

Exhibit 1

Organization of the Research and Development Program



ALTERNATIVE TREATMENTS FOR RELEASING CONIFER SEEDLINGS: A STUDY UPDATE[1]

Gary O. Fiddler and Philip M. McDonald[2]

Abstract: A study to find alternatives for releasing young conifer plantations on National Forests in northern California was started in 1980. The scope of the study has been enlarged to include State of California and private industry lands. Thirty two study sites have been established under three categories: National Administrative, Cooperative Release, and Timing of Release. The effects of chemical, manual, mechanical, and animal treatments on the survival and growth of conifer seedlings are being quantified. The oldest study site has had 7 growing seasons since the first treatments were applied. Preliminary findings are emerging. To release conifers, a radius of at least 5 feet is required. Caliper growth is the best indicator of release. Some of the newer chemicals give good results. Mechanical treatments require additional treatments to effectively control shrubs. Manual treatments may be worthwhile but are costly.

At the Fifth Annual Forest Vegetation Management Conference in 1983, held in Sacramento, California, a new national administrative study on alternatives to herbicides in vegetation management was described (Fiddler and McDonald 1984). It was a Forest Service effort with study sites in several regions. In the California Region, the study is a cooperative effort between the Pacific Southwest Region and the Pacific Southwest Forest and Range Experiment Station.

Since 1983 the study has increased in scope and number of study sites. It now has been divided into three categories, two of which are new. The National Administrative category, where all work is done by the same crew, has increased to 14 study sites located on 8 National Forests. The Cooperative Release category, which involves work by several crews, has 12 study sites located on Forest Service, State of California, and private industry lands. The Timing of Release category, which concerns defining the best time to release conifer seedlings, has 6 studies on Forest Service and private industry lands.

The purpose of this study is to quantify the effect of various chemical, manual, mechanical, and animal treatments on the survival and growth of conifer seedlings, woody shrubs, and other competing vegetation. The objectives of this study are to:

1. evaluate manual, chemical, animal, and mechanical release treatments

2. quantify treatment costs

3. determine tree growth/shrub quantity relationships

4. determine "best" treatment in terms of cost, survival, and growth.

For conifer seedlings, measurements include survival, damage, height, caliper, needle length, and needle color. Measurements on woody shrubs include density, cover, height, and frequency.

Categories of data that are being developed from these measurements include:

1. cost and production data

2. moisture stress relationships

3. conifer responses

4. shrub dynamics.

STUDY AREAS

The study is divided into three categories (table 1): National Administrative, Cooperative Release, and Timing of Release.

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[1] Presented at the Eight Annual Forest Vegetation Management Conference, November 4-6, 1986, Sacramento, California.

[2] Supervisory Forester, Pacific Southwest Region and Research Forester, Pacific Southwest Forest and Range Experiment Station, Redding, California

Table 1.--Vegetation Management Study Areas

Study Area[1]	Conifer Spp.[2]	Target Spp.	Treatment	Area/Type
National Administrative				
Klamath NF	DF	deerbrush	control	
Salmon River RD		grasses	crop tree release	2,3,4,& 6' radius
			directed spray	2,4-D[3], 3' radius
			directed spray	2,4-D, entire plot
Shasta-Trinity NF	DF	deerbrush	control	
Big Bar RD		madrone	cut and spray	Garlon 3A
		tanoak	crop tree release	5' radius
			directed spray	2,4-D, Garlon 4, and 2,4-D plus Garlon 4
Six Rivers NF	DF	manzanita	control	
Gasquet RD		deerbrush	directed spray	2,4-D, Garlon 4, and 2,4-D plus Garlon 4
		tanoak		
			crop tree release	5' radius
			cut and spray	Garlon 3A
Six Rivers NF	DF	snowbrush	control	
Gasquet RD		manzanita	crop tree release	5' radius
		tanoak	directed spray	2,4-D, Garlon 4, and 2,4-D plus Garlon 4
			cut and spray	Garlon 3A
Lassen NF	PP	manzanita	control	
Hat Creek RD		chinkapin	grub	100%
		snowbrush	simulated aerial	2,4-D, Velpar
			manual crop tree release	4' radius
			chain saw crop tree release	4' radius
Shasta-Trinity NF	PP	manzanita	control	
McCloud RD		chinkapin	crop tree release	2, 4, & 6' radius
		snowbrush	simulated aerial	2,4-D
		grasses	directed spray	Velpar
Tahoe NF	PP	deerbrush	control	
Foresthill RD	SP		grub	100%
	DF		grub	5' radius
			simulated aerial	2,4-D, Velpar
Tahoe NF	PP	deerbrush	control	
Downieville RD	DF		simulated aerial	2,4-D
	SP		directed spray	2,4-D, 3' & 5' radius
			cut brush	100%
Plumas NF	PP	deerbrush	control	
Quincy RD	DF	manzanita	simulated aerial	2,4-D, Velpar
		chinkapin	grub	100%
			crop tree release	2' and 4'radius
			simulated aerial	Roundup
Plumas NF	PP	snowbrush	control	
Quincy RD	JP	manzanita	Hydro-ax	
		chinkapin	Hydro-ax	2,4-D

Tahoe NF Nevada City RD	PP	manzanita	control	
		whitethorn	Trac-mac	
		bittercherry	Trac-mac	2,4-D
Tahoe NF Downieville RD	PP DF	deerbrush	seedlings	
			seedlings, brush	
			seedlings, brush, deer	
			seedlings, brush, deer and sheep	
Modoc NF Big Valley RD	PP	grass	seedlings	Velpar
			seedlings, grass	
			heavy grazing	
			acceptable grazing	
Eldorado NF Amador RD	PP	bearclover	control	
			directed spray	Roundup
			simulated aerial	Velpar
			simulated aerial	Escort
			simulated aerial	Arsenal

Cooperative Release

Klamath NF Oak Knoll RD	PP	live oak	control	
			cut and spray	Garlon 3A
			directed spray	Garlon 4
			directed spray	Velpar
			crop tree release	100%
Klamath NF Salmon River RD	PP	deerbrush	control	
			release, 1 time	100%
			release, 2 times	100%
			crop tree release	5' radius
Klamath NF Happy Camp RD	DF	tanoak	control	
		madrone	cut and spray	Tordon 101
			cut and spray	Garlon 3A
			cut,spray, and burn	Tordon 101
			cut,spray, and burn	Garlon 3A
			cut,burn, and directed spray	Garlon 4
Six Rivers NF Mad River RD	DF	tanoak	control	
			crop tree release	5' radius
Plumas NF Oroville RD	DF	tanoak	control	
			collars	3' radius
			collars	5' radius
Plumas NF Oroville RD	DF	tanoak	control	
			basal	Alumagel
Plumas NF Milford RD	JP	snowbrush	brush, seedlings, sheep	
			seedlings, brush	
			seedlings	4 ft. radius
			seedlings	Velpar
Shasta-Trinity NF Yolla-Bolla RD	PP	forbs	control	
		grasses	grub, 1 time	2' radius
			grub, 3 times	2' radius
			grub, 1 time	5' radius
			grub, 3 times	5' radius
			collars	1.5' radius

Eldorado NF	PP	whitethorn	collars,tar paper	20" radius
Amador RD		lupine	collars,felt	20" radius
			collars,Terramat	20" radius
			collars,Pacific weave	20" radius
			collars,Horto paper	20" radius
			collars,black plastic	20" radius
			control	
			directed spray	Velpar
Eldorado NF	PP	deerbrush	control	
Amador RD		manzanita	seedlings only	Velpar
				Velpar (ULW)
				Pronone
Sequoia NF	PP	manzanita	control	
Hot Springs RD			directed spray	Velpar
			collars, thick	5' radius
			collars, thin	5' radius
			collars, sandwich	2' radius
Latour State Forest	PP	chinkapin	simulated aerial	Velpar
			simulated aerial	Garlon 4
			simulated aerial	Escort
			control	

Timing of Release

Shasta-Trinity NF	PP	manzanita	control	
Mt. Shasta RD		snowbrush	crop tree release	Free to grow 1st 3 years
		grasses	crop tree release	Free to grow 2nd 3 years
		chinkapin		
Klamath NF	PP	manzanita	control	
Goosenest RD		snowbrush	crop tree release	Free to grow 1st 3 years
		chinkapin	crop tree release	Free to grow 2nd 3 years
Mendocino NF	DF	whitethorn	control	
Corning RD		manzanita	crop tree release	Free to grow 1st 3 years
			crop tree release	Free to grow 2nd 3 years
Plumas NF	JP	manzanita	control	
Quincy RD		squawcarpet	crop tree release	Free to grow 1st 3 years
		deerbrush	crop tree release	Free to grow 2nd 3 years
Santa Fe-Pacific	WF	manzanita	control	
Stephens Pass	RF	snowbrush	crop tree release	Free to grow 1st 3 years
		grasses	crop tree release	Free to grow 2nd 3 years
			free to grow	Study life
Santa Fe-Pacific	WF	whitethorn	control	
Bunker Hill	RF	ribes	crop tree release	Free to grow 1st 3 years
		forbs	crop tree release	Free to grow 2nd 3 years
			free to grow	Study life

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[1] NF = National Forest; RD = Ranger District

[2] DF=Douglas-fir; PP=Ponderosa pine; SP=Sugar pine; JP=Jeffrey pine; RF=Red fir

[3] Trade names and commercial enterprises or products are mentioned solely for information. No endorsement by the U.S. Department of Agriculture is implied.

Treatments being evaluated in the National Administrative category include:

1. Untreated control.

2. Manually saw or grub around conifer crop trees to predetermined radii of 2, 3, 4, 5, or 6 feet and repeat treatment up to three times.

3. Manually cut or grub all woody shrubs on plots.

4. Hand cut all woody shrubs and chemically treat stubs (daub or direct spray).

5. Direct spray with herbicides or mixture of herbiqides to prescribed radii, with a second application as needed.

6. Simulation of helicopter herbicide application, with a second application as needed.

7. Mechanically treat shrubs using heavy equipment, such as the Hydroax or Trac-Mac.

8. Mechanically treat shrubs as in treatment 7 and apply 2,4-D two years later to sprouting plants.

9. Use of cattle and sheep to control competing shrubs by grazing.

All treatments under the National Administrative category are applied by the same crew, assuring uniformity of rates and procedures.

The second category is Cooperative Release studies. These are located on Forest Service, State, and private industry lands, and differ from the National Administrative areas in that the land owner applies the treatments and takes measurements to the same standards as in the National Administrative areas. Twelve study areas have been established to date under this category. Some treatments not included under the National study are being tested under this category. These include use of mats to prevent shrub regrowth following site preparation. The mats are made of kraft paper, felt, or some other synthetic fiber, and range from 4- to 10- feet square. They show promise for grasses, forbs, and shrub species such as deerbrush, but are doubtful for more vigorous shurbs with stiff stems, such as, tanoak, where use is limited. This is because, though firmly pinned to the ground, the mats are lifted up by the stems of the growing shrubs. The wind then is able to get under the mats and blow them over the conifer seedlings.

Another treatment tried on tanoak is the use of Alumna-Gel which is a form of jellied gasoline. A shallow ditch is dug around the tanoak stump to expose the root collar. Alumna-Gel is poured into the ditch and set on fire. The intense heat is supposed to kill the buds and prevent sprouting. Results to date have been varied and this study is continuing.

The third category is the Timing of Release studies. These are located on private industry and National Forest lands; seven have been established to date. Their purpose is to determine what period in a conifer seedling's life is the most critical in terms of competing vegetation. In other words, if it is impossible to keep conifer seedlings free of competing vegetation throughout their life, what is the most critical period for them to be free to grow? Treatments include:

1. Control.

2. Maintain area free of competing vegetation for first 3 years, then let it develop naturally for the next 7 years.

3. Let vegetation develop naturally for first 3 years, then eliminate it and keep it eliminated for next 3 years.

4. Keep area free of competing vegetation for the life of the study.

With the three categories of studies, National Administrative, Cooperative Release, and Timing of Release, there are a total of 32 study sites located throughout northern California. The oldest one has had 7 growing seasons since the first treatments were applied. The intent of the study is to produce publications that will report results as soon as possible, with final results published for each study site at the end of 10 years. Several publication outlets will be utilized, although the majority will be Station research papers published through the PSW's Berkeley office. The first one, "Release of Douglas-fir seedlings: growth and treatment costs", is now available. It is Research Paper PSW-182. Two others are being written with publication planned for 1987.

The large number and broad range of studies gives us a good start on examining several alternatives for releasing conifer seedlings. If use of herbicides is limited or banned, the animal and mechanical techniques could prove especially valuable. Use of animals to control competing, but palatable, shrubs provides an opportunity for vegetation control and also early dollar returns from meat and hides. Even though thousands of acres of land in California have been mechanically treated, knowledge on the effectiveness of this technique is lacking. Of particular interest is use of different combinations of animal, mechanical, manual and herbicide treatments. Real opportunities for controlling competing shrubs, forbs, and grasses are possible here, and at a reasonable cost. For all alternatives, the treatment cost/seedling growth relationship should help the forest land manager in decision making.

EARLY OBSERVATIONS

In conclusion, some preliminary findings are emerging from the study:

1. When releasing conifers, a radius of at least 5 feet is required before the conifers show any significant response.

2. Caliper growth is consistently the best indicator of release. Height growth, at least of Douglas-fir, seems to be independent of competition level.

3. Mechanical shrub control appears ineffective without additional treatment of shrubs.

4. Manual treatments appear costly but worthwhile for controlling non-sprouting species, especially if applied when weeds are young and not well established.

5. Some of the newer chemicals are giving effective and lasting results. At least two of our trials show release lasting up to three years from a single application of Velpar. Garlon 4 has given good control of tanoak to date and this control has carried over in the form of reduced sprouting.

6. The most consistent finding is that early release, one or two years after planting, is essential not only for conifer seedling survival, but also for growth. Waiting three years before releasing conifers usually results in growth losses that will never be made up.

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March 5, 1990

Addendum to "A Study Update"

Cooperative Release Studies

Study Area	Conif. Spp.	Target Spp.	Treatment	Area/type
Plumas NF	PP	deerbrush (older)	seedlings, sheep seedlings, no sheep	
BLM	DF	tanoak	chainsaw rel. annually yrs 1-10	entire plot
Arcata RA		chinkapin	chainsaw rel. yrs 0,1, 2,5,10	entire plot
			chainsaw rel. yrs 0,5,10	entire plot
			control	
BLM Arcata RA	DF	grasses forbs	polypropylene mulch	5' radius
			polypropylene mulch	1' radius
			scalp	1' radius
			control	
Stanislaus Mi Wok RD (Burned area)	PP	bearclover seeded grass	simulated aerial	Velpar (ULW)
			simulated aerial	Garlon 4
			simulated aerial	Roundup
			control	
Stanislaus Mi Wok RD (Unburned)	PP	bearclover natural grasses	simulated aerial	Velpar (ULW)
			simulated aerial	Garlon 4
			simulated aerial	Roundup
			control	
Boggs Mtn. State Forest	PP	natural vegetation	opening sizes from 1/4 to 1 3/4 acres	
Lassen NF Hat Cr RD	PP	manzanita bitter cherry snowbrush	June 15	Trac Mac
			August 15	Trac Mac
			October 15	Trac Mac
Eldorado NF Georgetown RD	PP	manzanita	nursery run wind pollinated control pollinated	free to grow and with weeds in each genetic class

March 5, 1990

LIST OF PUBLICATIONS

National Administrative Study

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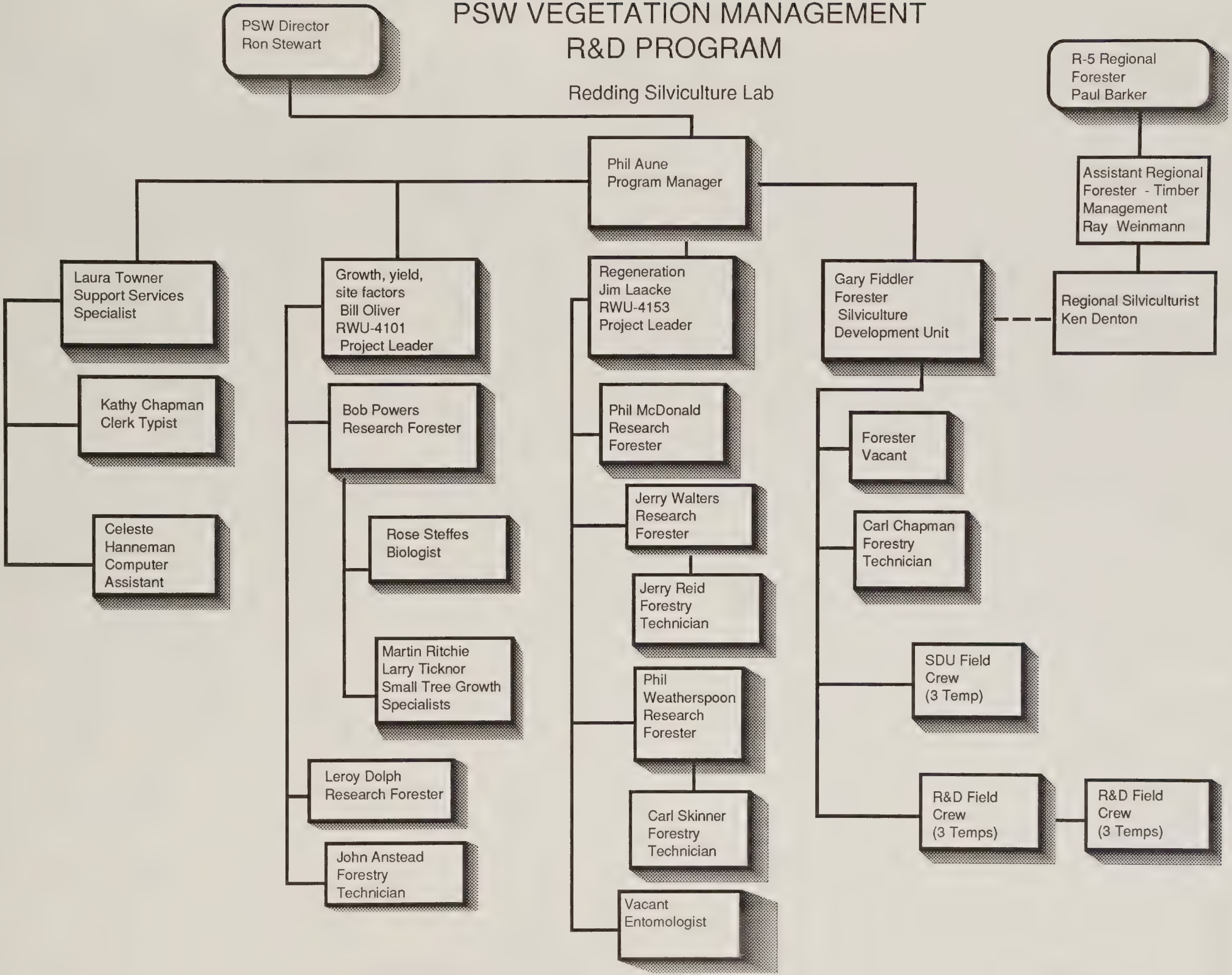
PSW VEGETATION MANAGEMENT
R&D PROGRAM

Redding Silviculture Lab



APPENDIX B
Ken Bentson

HERBICIDE USE RESEARCH NEEDS IN REGION 6

Kenneth P. Bentson, Research Chemist, PNW

R-6 has not had any herbicide use since the 1984 herbicide injunction. The injunction has precluded any research that utilizes herbicides. It is apparent, however, that there are several major areas of research that will be necessary to develop an integrated pest management program for vegetation that includes herbicides. Much of this research is necessary for private as well as public land managers.

The Pacific Northwest is typified by a wide diversity of social, biological, and physical environments. The social environment needs to be investigated in proximity to the National Forests and other timber production areas. Some means of incorporating the social attitudes of local and regional residents into vegetation management decisions should be developed, this goes beyond the NEPA process. Much of the herbicide controversy might have been circumvented if there had been judicious choices made about where to apply herbicides with respect to sensitive residents. Certain areas of the region have few residents concerned about herbicide applications, while other locales have a very strong anti-herbicide movement. Tailoring vegetation management prescriptions to the social environment would help to allay many current problems.

The biological and physical environments of the Pacific Northwest are diverse, ranging from arid rangelands to montane temperate rain forests. The herbicide injunction forced many districts to explore alternative methods of vegetation management, some of which have proven to be highly successful (e.g. hand pulling seedling snowbrush ceanothus, planting very large seedlings). There is a great need for the development of economic damage thresholds for competing plant populations as part of an integrated vegetation pest management program. Economic damage thresholds would establish a stronger basis for the prescription of vegetation management treatments, because treatment selection could be made on the basis of reducing damage to just below the economically damaging level. Identification of plant community and site characteristics, where herbicide applications are the only biologically and cost effective method of reducing damage, is essential to justify the use of herbicides. Some of this work is currently taking place at Oregon State University, however, an accelerated program of determining economic damage thresholds is necessary given the diversity of plant communities in the Pacific Northwest.

Systematic comparisons of the advantages and disadvantages of different vegetation management alternatives need to be made. These comparisons should consider site specific characteristics such as topography, climate, plant community, soils, landslide potential and social ramifications (e.g. visual impact, proximity to people, opinion surveys). For instance, there is currently little data comparing the efficacy, costs, worker exposure levels, and off-site consequences of aerial versus backpack applications of herbicides in different plant communities on sites of different slopes. The effect of slope may have a large impact on the

relative efficacy and worker exposure from backpack versus aerial applications, and thus would become a component in deciding which application technique is most suitable for a specific site. In some areas, the social consequences of aerial applications may be too great for its use.

Canopy penetration and spray adhesion of herbicide on different target plant's foliage needs to be investigated. The diversity of plant species (e.g. grasses, herbs, tanoak, madrone, ceanothus, maple, and manzanita) means that there are many different leaf orientations relative to droplet trajectories, and a wide variety of leaf surface characteristics. These factors have a large influence on the retention and uptake of foliar applied herbicides. Some vegetation types may be best treated with backpack applications because of leaf orientation, while others may have better spray capture from aerial applications. Canopy penetration and spray adhesion are critical in determining the initial environmental sites different fractions of the total herbicide residue is deposited. The site of deposition plays a fundamental role in the subsequent rate of degradation and transport of residues. Various factors which affect canopy penetration and spray adhesion that need to be investigated are drop size, formulation, spray volume, plant leaf surface characterisitics, plant physiological status, dew on foliage, humidity, and temperature. Data collected from this would increase the precision of the FSCBG canopy penetration prediction capabilities.

Environmental fate of herbicides needs study in the context of site specific conditions. Environmental fate studies for registration do not provide information useful for evaluating the potential fate of an herbicide under the variety of climatic and edaphic conditions that prevail in the Pacific Northwest. Consideration of temperature, humidity, insolation, soil types, litter, and vegetation need to be included in environmental fate studies that bridge the gap between the laboratory and field. Environmental fate information gathered along these lines could result in development of predictive models applicable to specific site conditions, and would be useful in site specific environmental assessments.

Models for the prediction of herbicide deposition site, degradation, volatilization, leaching, runoff, and groundwater contaminating potential need to be developed that can be applied to typical forest sites in the Pacific Northwest. The requirement for site specific environmental assessments means that land managers with little training in environmental and pesticide chemistry must make decisions outside their field of expertise. Expert systems to predict the transport of pesticides into sensitive systems (e.g. streams, groundwater, the atmosphere), given the unique conditions prevailing at specific sites and application times, would lead to scientifically defensible environmental assessments. These programs could be linked to geographic information systems. Expert systems would also aid in the development of monitoring systems that would specify where and when samples from different compartments of the system should be sampled.

APPENDIX B
M. Boyd Edwards

COMMITTEE MEMBER REPORT
NATIONAL STEERING COMMITTEE FOR AERIAL APPLICATION OF PESTICIDES-VEGETATION MANAGEMENT

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It is again a pleasure to have this opportunity to discuss the use and use needs for vegetation management in the southern United States.

As previously noted in last years Report, I have been involved in herbicide use research for approximately ten years and have worked closely with the herbicide industry, foresters in the timber industry, as well as State and Federal foresters for the purpose of determining application methods, herbicide screenings, and the training of herbicide applicators. My personal research efforts have been conducted in the Piedmont and Coastal Plains Region of the southern U.S.

At present, I anticipate aerial application of herbicides to be the "application method of choice" on large private tracts of forest land, and little or no aerial application to be made on public forest lands in the South. Most herbicide application on National Forest land in the South is being conducted by small, hand-crews on individual stems for low impact management objectives. Little or no broadcast of herbicides is being used.

At present we are conducting research to determine efficacy of specific herbicides on numerous species of woody and herbaceous plants for the purpose of establishing planted pine and releasing young pine stands from competition. In addition, there is interest in utilizing herbicides in natural regeneration of pine stands as well as for maintaining adequate species mixes in pine-hardwood stands. Also for the first time herbicides are being studied to determine how they create and maintain biological diversity in southern forests. This is vital information for proper management on National Forest lands today.

A few non-technical problems and needs are:

1. Train Forest Service field crews in making the proper prescription in order to achieve desired management objectives.

2. Maintain cooperation with environmental groups in order to explain the how-and-why of herbicide use in forests.

3. Train Forest Service personnel to deal with news media and general public in matters of forest management, ex. herbicide application.

4. Need to survey each National Forest by District to determine the need for vegetation management.

A few technical problems and needs are:

1. Need to determine the role of herbicides in creating and maintaining biological diversity in southern forests.

2. Need to determine rates of herbicides and time of application for vegetation control in specific physiographic regions in the South.

3. Need to utilize herbicides for improving stand quality in naturally regenerated stands.

4. Need to continue fate studies for herbicides in the forest ecosystem.

5. Need to conduct studies that utilize the aerial application of herbicides in order to determine if it is a feasible management tool on National Forest lands.

In summary I do not anticipate any aerial application being conducted on Forest Service land in the South. However, I would like to see research conducted with aerial application because it does have some advantages.

Again, I will issue an invitation to members of the National Steering Committee on Aerial Application of Pesticides-Vegetation Management to visit the southern U.S. for the purpose of observing vegetation management methods and problems - both on public and private lands.

APPENDIX B
Paul Mistretta

NOTES FROM REGION 8
FOR THE
NATIONAL STEERING COMMITTEE
FOR AERIAL APPLICATION OF PESTICIDES - VEGETATION MANAGEMENT
1990

Paul A. Mistretta

Program summary:

Information is presented in the form of abbreviated notes. I'll be glad to clarify any point further.

1) The regional process of developing programmatic vegetation management EISs is complete with the issuance of the Ozark/Ouachita document on March 5, 1990. Appeal process is not complete on any of the three documents.

   Among other points of note are the following:

   The program developed in the preferred alternatives includes vegetation management on 764,695 acres annually; of this 90,456 acres are allowed to be herbicidally treated.

   The EISs allow a larger herbicide program than at present in the Coastal Plain/Piedmont and Appalachian Mountain subregions while curtailing somewhat the current program in the Ozark/Ouachita Mountains.

   Only 2,900 of these acres may be done using aerial application.

   Broadcast ground application of herbicide, either manually or mechanically is severely curtailed in silviculture, though it is retained for wildlife treatments and rights-of-way.

   Emphasis is placed on using the lowest effective rate of the least environmentally and health sensitive herbicide.

   Reduction of the use of soil-active herbicides is strongly mandated.

   Approximately 100 mitigations are imposed; by far the largest method specific group is that which deals with herbicides (30+).

2) The risk analysis prepared as part of the EIS process shows aerial to be the safest method with regard to human health. All broadcast application fails under the environmental "biodiversity" criteria being used by "environmentalists". Neither the criteria or the standards under which failure is evaluated is codified for our analysis.

3) We were unable to give away 80 acres of demonstration turnkey Velpar ULW application in FY'89; no forest wished to be the first to reintroduce aerial application to the region.

4) One major FPM thrust is to incorporate mitigations in the EIS into prescriptions and general forest practice. This is being accomplished by:
   Training in conjunction with the ongoing regional restricted-use pesticide applicator certification training.
   Training at annual prescription schools.
   Ongoing evaluation of new products and tools which meet the mitigation needs of the forests.

5) Training is a major thrust. Two level certification: restricted use pesticide applicator certification and a new COR/Project Inspector Certification.

6) Major concerns, both internal and external, which are influencing our program include:
   - Endangered species
   - Diversity (as yet undefined, but a real catch all buzz word)
   - Application rates
   - Ground and potable water
   - Immunotoxicology and neurotoxicology (again buzz words, no protocols for evaluation are yet agreed on)
   - Cumulative effects

7) Currently involved in the national FPM FY'89 programmatic economic analysis.

8) Litigation and appeals are becoming a major drain on regional resources.

9) We are currently involved with Georgia Tech Research Institute and appropriate companies, in worker exposure studies on garlon 4 and roundup.

<u>Program needs</u>:

- Need some form of decision support or expert system to allow field level personnel produce environmental analyses which identify all applicable mitigations from the (at least) four separate EISs which apply to any parcel of land in the South. This program should resolve (or at least identify) conflicts where they occur.

- We need some form of a risk assessment program which will allow us to evaluate rates/times of exposure not permitted for use, but not shown to be hazardous in the EISs. This will allow truly site-specific analyses to be performed.

- Review available data on residual diversity (non-target survival) and identify major data gaps. Encourage and support research in this area.

- Need worker exposure studies on a few other herbicides to establish valid empirical modeling standards.

- Need an ongoing safety effort; including good training aids, equipment development or modification, clothing review and development, etc.

- Need some valid economics models to allow the projection of economic thresholds for control.

APPENDIX B
Ed Monnig

Report from Region 1
for the
National Steering Committee
For Aerial Application of Pesticides-
Vegetation Management
1990

Edward Monnig

INTRODUCTION

Last year's report from Region 1 noted the need for aerial application of herbicides to convert brushfields to fully stocked timberlands. Despite committments for this conversion in at least one Forest Plan, the Forests had yet to undertake the NEPA documentation. The situation remains the same at this time. Although the Forests are interested in the efforts of Regions 5 and 6 to complete the NEPA process for vegetation management activities, staff are somewhat skeptical that the process will be completed.

The Regional Office Timber/FPM staff remains committed to assist the Forests in completing the NEPA process on a site-specific basis. The RO has recently joined with Regions 2, 3, 4 and 10, in contracting for human health risk assessment for vegetation management activities. This assessment would be used as a background document for site-specific analysis. The Regional Office has also provided a Guide for Management of Problem Vegetation in Silvicultural Practices.

NEEDS AND ISSUES

In preparing this report the 1989 report by the National Steering Committee for Vegetation Management was reviewed. The needs and issues identified in the 1989 report remain remarkedly timely. In particular we would like to comment on four issues which seem very fundamental if progress is to be made in this area.

First, the role of various staff groups in the use of herbicides for vegetation management must be more clearly defined. In some cases FPM has assumed responsibility almost by default. Where responsibility is diffuse, it is often easy to defer the hard issues.

The lack of central staff role in herbicide management may also be associated with the lack central focus and organizational responsibility for herbicide research. It is apparent that research responsibility in the area of vegetation management and herbicide use must be assigned if progress is to be made on the other issues identified by the Steering Committee.

Second, increased information on the cost and benefit of herbicide use must be generated. In times of tight budgets, particularly with the escalating cost of NEPA compliance, line officers are demanding to know the benefits of a project or program before committing to extensive preparation.

Third, updated publications are needed to support training efforts and field use of herbicides for vegetation management. At the present time much of the institutional expertise in this area has disappeared.

Finally, the issue of biodiversity has become increasingly important in public comment on Forest activities. Herbicide use will likely be perceived as a threat to biodiversity. Increased research in this area is necessary to define the extent of this problem.

As noted above, the variety of other needs and issues identified by the Steering Committee are appropriate. The resolution of four identified above is particularly fundamental if progress is to be made in other issue areas and if committment is to be generated for these vegetation management activities.

APPENDIX B
Don Perala

Report to the National Steering Committee for Aerial Application of Pesticides-Vegetation Management

by

Donald A. Perala
Research Forester
North Central Forest Experiment Station
Grand Rapids, MN

7 March 1990

Sacramento, CA

Herbicide use/needs ha~~s~~ve not changed dramatically within Research Work Units in NCFES over the last year. Only a handful of scientists are conducting research relating to or requiring herbicides.

E. Hansen, Forestry Sciences Laboratory, Grand Rapids, MN, is conducting a 10-year pilot project with short rotation intensively cultured poplar plantations on several soil types over broad climatic conditions. The objective is to determine which poplar clones survive and grow best on specific soil types and under specific microclimates, and to determine if any clones survive and grow well over a wide range of environments. The sites are within the area bounded by the eastern edge of the Dakotas, to Michigan, and south into Iowa on agricultural cropland of average or better productivity with a medium texture. About 80 hybrid poplar clones were planted at each site, one replication in 1987 and a second replication in 1988. Roundup is used for site preparation to control quack grass and other perennials, and Linuron just prior to planting or up to 10 days thereafter. Linuron is used prior to leaf-on during the succeeding two years as needed. Simazine granules are handy for use at any time, but are expensive. They are safe for poplars that are 1+ years old and if the soil has more than 1.5% organic matter. Other herbicides used are Fusilade and Poast for summer direct spray for quack grass and foxtail. These herbicides are reasonably effective for establishing hybrid poplars on set-aside croplands.

D. Stone and A. Harris, Forestry Sciences Laboratory, Grand Rapids, MN, in May, 1989, began a three-year study on the fate of three soil active herbicides and their decomposition products under the influence of soil organic matter and rainwater acidity in low base-saturated sand soils treated with acidified rainwater. Leaching characteristics of ^{14}Carbon-[illegible] labeled hexazinone (Velpar), sulfometuron methyl (Oust), and tebuthiuron (Spike) at 1 gallon per acre of Velpar L, 2 ounces per acre of Oust, and 2.5 pounds per acre of Spike 80 W are being evaluated in 15 x 150 cm lysimeters. Treatments include one of three organic matter (litter-humus) levels: sand (control), jack pine, or mixed hardwood, and preconditioning with acidified rainwater at pH 5.4 or 4.2 for four years. The combination of soil texture, low base- saturation, and preconditioning with acid precipitation provide "worst case" conditions for the upper Great Lakes region. Rainwater is collected from a greenhouse roof, acidified with nitric and sulfuric acids, and applied at an annual rate of 800 mm. ~~The herbicides were spiked with ^{14}Carbon labeled material and applied at ordinary rates.~~ The three organic matter treatments, two acidity levels, three herbicides, and six replications require 108 lysimeters. One-third of the columns will be broken down after each of three seasons and analyzed to determine the distribution and activity of herbicides and metabolites. On week 7, after about 9 inches of rainwater had been applied, traces of ^{14}C-labeled products were detected in leachate from 22% of the columns treated with Velpar and from one of the columns treated with Spike. After 9 weeks of treatment and nearly 12 inches of water, ^{14}C-labeled compounds were detected in 72% of the columns treated with Velpar and 22% of those treated with Spike. After 17.6 inches of rainwater over a 14-week period, ^{14}C activity was detected in leachate from 97% of the Velpar columns and 64% of Spike columns. Actual precipitation recorded

during the 14 weeks was 12.26 inches. Of the 1,080 leachate samples from the 150 cm level that have been analysed, ^{14}C activity has been detected in only 96 samples and levels are very low. The ^{14}C-labeled compounds that have been detected probably are metabolites rather than parent compounds that have relatively short half-lives. No labeled compounds have been detected in leachate collected at 150 cm from the columns treated with Oust. Of the leachate collected at the 10, 20, and 40cm levels, only the 20 cm level has been analysed for ^{14}C activity; labeled compounds were detected in columns treated with all three products. Apparently most of the chemicals remain in the upper soil. Concentrations of parent compounds and metabolites in all ^{14}C labeled leachate and soil samples are still being determined.

H. M. Rauscher (Forestry Sciences Laboratory, Grand Rapids, MN) and M. Butler-Fasteland (U. MN) have developed a prototype advisory system for herbicide selection and application method. A version will be available for users by Fall 1990.

B. Haissig, Forestry Sciences Laboratory, Rhinelander, WI, recently presented a paper at the AAAS annual meeting in New Orleans that described how gene splicing of Salmonella into Populus can produce Roundup-resistant seedlings. The wire services picked the story up and it was widely disseminated.

APPENDIX B
Mike Rutty

POTENTIAL AERIAL HERBICIDE APPLICATION NEEDS IN THE CENTRAL SIERRA NEVADAS

1. Aerial application of glyphosate on bearclover. It has been said that this is not an effective application, but I have not seen any real evidence of that. (Nor have I seen any evidence that it would be a good application). Suggest that this be examined. Should also be examined in conjunction with potential adjuvants. There may be a working combination.

2. Registration of Escort (which showed a lot of promise) has been dropped or at least greatly delayed. We may wish to encourage its registration. (Note that while the R5 EIS for herbicide use in reforestation discussed 13 or more herbicides we are now down to using four).

3. The Dupont formulation of ULW velpar shows tremendous potential for use. The Stanislaus is very serious in wanting to be a customer for this formulation. It fits perfectly with the site prep we will need to do on the burn especially the holding action we are considering on the steep grounds.

4. There have been some minor efforts in the past to determine what the optimum pressure bomb readings could or should be on target and retention species at the time of an application of herbicides. (This may not even be significant but at this point we don't really know). This may have the potential to yield very useful data?

5. A few years ago there was a commotion over "laser" herbicides. Where are we with these? Is there a potential for such things? How far in the future?

6. "New Perspectives in Forestry" is going to cause a lot of changes in the near future. It may be that we'll see greatly reduced ability to use aerial applications at least for foliar active applications, but soil active agents may still be possible.

    a. In partial cut stands where a mix of species is present, will aerial applications take out all sensitive trees of all sizes?

    b. With an aerial application of a granular formula in such a stand can we hit an acceptable amount of the target brush?

    c. Someone needs to consider the implications of this on ground applications. IE. Spot gun treatments, ground based machine applications, and hand applications. Worker safety, efficacy, effects on non target species. Some real fine tuning will be needed on these types of projects.

7. Training. Region 5 made a good effort last year in the training of people for pesticide applications. This needs to continue. We need continuing education requirements in our certification standards. The Service, the Region and the Forests need to actively continue with followup training. There are subjects which need to be addressed in greater depth along with new topics which are arising.

8. Computer modeling. A computer model which when fed the chemical to be used and all the target and non target species present on site along with site parameters would yield estimates of damage to the various species. We usually have a good idea of the effect on the primary target species and the on site commercial conifers, but the other species (as well as some of the target species) are rapidly becoming more and more significant as considerations when planning herbicide applications. With ground applications we can usually manage by avoidance. This is a lot more difficult with aerial applications.

APPENDIX B
Fay Shon

Pacific Northwest Region Report for 1989 to the National Steering Committee (Vegetation Management)

During 1989 the Pacific Northwest Region entered into a court ordered mediation on the final EIS for Managing Competing and Unwanted Vegetation (EIS). On May 24, 1989, a Mediated Agreement was signed by three parties and the Forest Service. The Mediated Agreement provided further detail on how the Record of Decision (ROD) for the final EIS was to be implemented. In conjunction with the ROD and Mediated Agreement, the Region has begun to implement the final EIS, with the exception of chemical alternatives. Chemical alternatives are currently prohibited by an administrative stay which will not be resolved until all administrative appeals have been completed.

To implement the ROD and Mediated Agreement a guide, entitled "A Guide to Conducting Vegetation Management Projects in the Pacific Northwest Region" (Guide), has been developed. The Guide incorporates existing direction from both the ROD and Mediated Agreement. The six chapters included are: 1) Site Specific Environmental Analysis; 2) Public Involvement - Working with People; 3) Worker Health - Protection and Reporting; 4) Working with Cooperators; 5) Monitoring; and 6) Information Packages for available herbicides and five treatment methods. Among the new provisions are a form for contractors to report health effects (Forest Service employees continue to use forms CA-1 and CA-2) and a provision for maintaining health effects records for 30 years. The Guide also provides direction for implementing the preferred alternative in the EIS, prevention, and describes four other vegetation management strategies: early treatment, maintenance, correction, and no action.

In addition to developing the Guide, Region Six Forest Pest Management has provided information and briefing sessions to the National Forests, outside Cooperators, other federal and state agencies, and continues to meet with the signers of the Mediated Agreement.

Current research needs in the vegetation management area include decision making models to predict outcomes from selecting various types of vegetation management methods or combination of methods, and evaluation of various vegetation management techniques.

APPENDIX B
Larry Yarger

REGION 9 NOTES
STEERING COMMITTEE MEETING - VEGETATION MANAGEMENT
SACRAMENTO, CA

Larry Yarger
Forest Pest Management
NA-S&PF/Region 9

March 7-8, 1990

INTRODUCTION

In the Eastern Region, herbicides are prescribed for use primarily to release conifer stands, prepare sites for planting or seeding, and to establish and maintain permanent or wildlife openings. Additional reasons for using herbicides include: general weed control around structures and in campgrounds, management of range vegetation and noxious weeds, improvement of aquatic and riparian habitats, nursery management, and maintrenance of road, trail and utility rights-of-way.

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Since 1984, Forests have pursued development and evaluation of ground application techniques. The deferment of aerial application of herbicides can be viewed as "igniting" interest in ground application techniques in the Region. However, just as motivating was the building interest in developing application techniques that were "sensitive" to multi-resource values. Techniques that allowed more flexibility in the degree of herbicide coverage were being viewed as more "integrated." Strip, spot, and thinline treatments were being considered and evaluated as possible alternatives to broadcast treatments. Actually, resource values other than timber, such as wildlife, but also visual and aesthetic values, were receiving increased emphasis during the prescription process.

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The Eastern Region has essentially transited from a Region that considered the use of aerial equipment a viable vegetation management alternative, to one that now relies entirely on ground application techniques. However, the Region desires to maintain the option of using aerial techniques on in-service projects, and to be in a position to allow permittees the option of using aerial techniques to manage vegetation along utility rights-of-way. Before aerial techniques can be "reinstated" as a viable alternative, a major "hurdle" for the Region from an administration standpoint, is the need to develop and document an environmental analysis that considers aerial application techniques. The last environmental document prepared by the Region that discussed aerial techniques was issued in 1978. This document is dated, and no-longer considered a viable NEPA document. The Region has established several Forest teams to address the NEPA compliance issue. The Allegheny NF has already issued their NOI; the Chippewa and Superior NF are proceeding to develop and EIS, as are the Chequamegon, Nicolet and Ottawa NFs.

For at least the life of the current Forest Plans, the Region anticipates that relatively few acres would be proposed for treatment using aerial techniques even if the aerial application alternative became viable. The reasons for this are: 1) the number of acres proposed for treatment to release conifer plantations or prepare sites for artificial regeneration is expected to continue a slight downward trend over the life of current Forest Plans, 2) increased interest in non-broadcast application methods, 3) terrain is not a limiting factor to the use of ground equipment in most of the Region (significant exception are utility rights-of-way in southern Ohio and West Virginia), and 4) public sensitivity to aerial methods. However, information now surfacing as a result of human health risk assessments prepared in several

Regions necessitates another evaluation of the viability of using aerial techniques in Region 9.

Currently, Forests in the Region are not conducting pilot projects, or field evaluations, of herbicides using aerial application equipment. However, the Region needs to stay current in aerial application technology, or be able to acquire aerial application expertise, in the event that this alternatives becomes viable. The Region expects that utility rights-of-way permittees will continue to request approval to use aerial methods in the mountainous areas of West Virginia and southern Ohio. We also expect State agencies, and industrial forest land owners, especially in the Lake States area, as well as several Federal agencies, will continue to apply herbicides aerially. Pilot tests in the use of aerial methods of applying herbicides would benefit these Forest Service cooperators, as well as provide valuable information in the event that the Region proposed the use of aerial treatments on National Forests.

The Region's primary concern is focused on the NEPA compliance issue. The Region has taken steps to address this issue with Forest teams, primarily in the Lake States area.

A summary of herbicide-use is enclosed. Several non-technical and technical needs are addressed below:

a. Non-Technical Problems and Needs:

(1) **NEPA.** The Region is moving toward compliance with NEPA. Several Forest teams are in the process of developing EIS's. The Regional Office is developing a human health and wildlife risk assessment.

(2) **Benefits from Non-Aerial Methods.** The advantage of using ground techniques over aerial techniques to selectively treat areas has received considerable interest on the part of Forests. By using selective treatments rather than broadcast treatment, resource values, in addition to the primary purpose for managing vegetation, can be achieved in treatment areas.

(3) **Public Acceptance.** For the most part, the public is more receptive to proposed herbicide applications when the method of application involves ground rather than aerial equipment.

b. Technical Problems and Needs:

(1) **Technical Training and Technology Transfer.** Several years of non-activity in the aerial application field has resulted in a degradation, or least stagnation, of technical skills. Forests have not kept up with state-of-the-art methods of applying herbicides aerially, nor basic project planning and administration procedures.

Forests have benefited from work accomplished by R8, NEFES, and NCFES.

(2) **Evaluation Procedures.** Forests need to state-of-the-art methodologies for conducting pre- and post-treatment evaluations.

SUMMARY OF PESTICIDE-USE IN REGION 9, 1986-89

PESTICIDE	1986		1987		1988		1989	
	ACRES	LBS. AI	ACRES	LBS. AI	ACRES	LBS. AI	ACRES	LBS. AI
FUNGICIDES & FUMIGANTS	346 250 lbs. seed	4,003	197	2383	122	457	84	200
HERBICIDES & ALGICIDES	22,734	39,887	18,578	30,324	15,790	17,139	12,188	19,387
INSECTICIDES	419 29.7M BIUs	118	35,945 541.8M BIUs	15	8,928 142.2M BIUs	40	43,073 456.7M BIUs	625
PISCICIDES	2	5	3	5	0	0	0	0
REPELLANTS & RODENTICIDES	0 142 lbs. seed	2	0 80 lbs. seed	16	0 65 lbs. seed	0	0 50 lbs. seed	3
TOTAL USE	23,501 392 lbs. seed 3.5M BIUs	44,038	54,723 80 lbs. seed 541.8M BIUs	32,743	24,840 142.2M BIUs	24,643	55,345 50 lbs. seed 456.7M BIUs	20,215
HERBICIDE (major categories) 1/								
SITE PREPARATION	1,930	4,174	2,266	3,619	2,130	2,957	1,713	1,372
CONIFER RELEASE	11,851	12,393	7,589	10,376	6,957	9,457	4,599	5,331
RANGE MANAGEMENT & NOXIOUS WEEDS	1,161	552	629	457	944	603	1,112	836
WLD. HABITAT IMPROVEMENT	4,400	10,098	5,515	6,787	3,459	5,719	3,989	4,781
ROWS, ROADS & TRAILS	2,421	9,173	1,284	6,612	1,739	4,189	435	3,415
NURSERIES	24	43	68	212	32	138	18	3,340
SPITTLEBUG IPM	478	744	772	1,179	238	330	0	0

1/ Ground applications.

LYARGER 12/89

SUMMARY OF PESTICIDE-USE IN REGION 9, 1989 1/

ACRES TREATED BY FOREST

	ANF	CHF	CPF	GMF	HIF	HMF	MTF	MNF	NIF	OTF	SHF	SUF	WHF	WMF	TOTAL
FUNGICIDES & FUMIGANTS	0	0	0	0	0	0	0	2	0	82	0	0	0	0	84
HERBICIDES															
Aquatic Weeds 2/	0	0	0	0	0	0	7	4	0	0	0	0	0	0	11
Conifer Release	0	169	925	0	195	0	1838	0	989	416	0	0	67	0	4599
General Weed Control	0	0	0	0	2	0	0	6	212	0	0	0	0	0	220
Hardwood Release	0	0	0	0	0	0	61	0	0	0	0	0	0	0	61
Noxious Weeds	0	0	0	0	0	0	550	0	0	0	0	0	0	0	550
Nursery	0	0	0	0	0	0	0	0	0	18	0	0	0	0	18
Research	0	0	0	0	0	0	0	30	0	0	0	0	0	0	30
Range Management	0	0	0	0	0	0	442	0	0	0	0	0	120	0	562
Rights-of-Way	80	56	0	41	0	29	196	30	0	3	0	0	0	0	435
Site Preparation	1706	7	0	0	0	0	0	0	0	0	0	0	0	0	1713
Wildlife Improvements	0	394	49	0	0	0	3021	0	511	0	0	0	0	14	3989
SUBTOTAL HERBICIDES	1786	626	974	41	197	29	6115	70	1712	437	0	0	187	14	12188
INSECTICIDES 3/ (G)	0	0	0	0	0	0	0	1	31	16	0	0	84	0	132
(A)	42170	0	0	0	0	0	0	771	0	0	0	0	0	0	42941
SUBTOTAL INSECTICIDES	42170	0	0	0	0	0	0	775	31	16	0	0	84	0	43073
RODENTICIDES & REPELLANTS (pounds of seed)	0	0	0	0	0	0	50	0	0	0	0	0	0	0	50
TOTAL ACRES TREATED	43956	626	974	41	197	29	6115	844	1743	535	0	0	271	14	55345
POUNDS OF SEED TREATED	0	0	0	0	0	0	50	0	0	0	0	0	0	0	50

1/ Compiled from FS 2100-1 forms.
2/ Includes algicides.
3/ A=Aerial applications.
G=Ground applications.

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HERBICIDE-USE IN REGION 9, 1986-89

	ACRES TREATED				
HERBICIDE	1986	1987	1988	1989	(lbs. A.I. in 1989)
AMITROLE	4	0	0	0	0
AMMONIUM SULFAMATE	414	530	525	32	112
ATRAZINE	80	45	140	313	314
ATRAZINE/GLYPHOSATE	0	20	0	0	0
BIFENOX	14	15	0	0	0
BROMACIL/DIURON	0	96	10	80	480
CACODYLIC ACID	8	0	0	0	0
COPPER TRIETHANOLAMINE	0	0	0	1	1
DALAPON	12	0	0	0	0
DACTHAL	0	2	0	0	0
DICAMBA	38	41	8	10	2
DICAMBA/2,4-D	0	2	3	0	0
DICHLOBENIL	1	0	0	0	0
DIQUAT	10	0	0	0	0
DIURON	90	0	1	24	24
DIURON/ATRAZINE	0	0	3	0	0
DIURON/OUST	0	0	0	1	2
ENDOTHALL	47	81	0	0	0
FOSAMINE AMMONIUM	12	362	426	136	2415
GLYPHOSATE	3241	2110	3706	2658	3656
GLYPHOSATE/ATRAZINE	0	0	25	0	0
GLYPHOSATE/OUST	216	220	21	442	473
GLYPHOSATE/SIMAZINE	1	0	0	0	0

HERBICIDE-USE IN REGION 9, 1986-89 continued

HERBICIDE	ACRES TREATED 1986	1987	1988	1989	(lbs. A.I. in 1989)
HEXAZINONE	7300	7430	4417	3289	4081
HEXAZINONE/OUST	0	2	0	0	0
IMAZPYR	0	4	10	10	10
LINURON	15	0	0	0	0
MCPA	85	0	0	85	170
MEFLUIDIDE	1	0	0	0	0
MEFLUIDIDE/DICAMBA	24	0	0	0	0
METOLACHLOR	15	0	0	0	0
MINERAL SPIRITS	0	0	0	7	3320
NAPROPAMIDE	0	35	0	3	14
OUST	1082	511	425	512	73
OXYFLUORFEN	4	6	0	3	2
PICLORAM	1782	733	475	293	105
PICLORAM/FOSAMINE AMMONIUM	0	7	12	0	0
PICLORAM/2,4-D	3817	2629	2454	1599	770
PICLORAM/2,4-D/ TRICLOPYR	323	334	514	0	0
PICLORAM/2,4-DP/ TRICLOPYR	40	0	0	0	0
SIMAZINE	18	9	13	4	8
SETHOXYDIN	0	10	0	3	1
TEBUTHIURON	244	492	729	677	510
TRICLOPYR	1522	1347	765	1209	996
TRICLOPYR/2,4-D	10	10	29	5	15
TRICLOPYR/PICLORAM	0	185	0	45	205
2,4-D	1309	943	1114	609	1507

HERBICIDE-USE IN REGION 9, 1986-89 continued

HERBICIDE	ACRES TREATED 1986	1987	1988	1989	(lbs. A.I. in 1989)
2,4-D/2,4-DP	574	123	30	32	40
2,4-D/2,4-DP/DICAMBA	18	5	100	106	81
2,4-D/2,4-DP/TRICLOPYR	182	133	0	0	0
2,4-DP	0	0	25	0	0

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REGION 9 NOTES
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Currently, Forests in the Region are not conducting pilot projects, or field evaluations, of herbicides using aerial application equipment. However, the Region needs to stay current in aerial application technology, or be able to acquire aerial application expertise, in the event that this alternatives becomes viable. The Region expects that utility rights-of-way permittees will continue to request approval to use aerial methods in the mountainous areas of West Virginia and southern Ohio. We also expect State agencies, and industrial forest land owners, especially in the Lake States area, as well as several Federal agencies, will continue to apply herbicides aerially. Pilot tests in the use of aerial methods of applying herbicides would benefit these Forest Service cooperators, as well as provide valuable information in the event that the Region proposed the use of aerial treatments on National Forests.

The Region's primary concern is focused on the NEPA compliance issue. The Region has taken steps to address this issue with Forest teams, primarily in the Lake States area.

A summary of herbicide-use is enclosed. Several non-technical and technical needs are addressed below:

a. Non-Technical Problems and Needs:

(1) **NEPA.** The Region is moving toward compliance with NEPA. Several Forest teams are in the process of developing EIS's. The Regional Office is developing a human health and wildlife risk assessment.

(2) **Benefits from Non-Aerial Methods.** The advantage of using ground techniques over aerial techniques to selectively treat areas has received considerable interest on the part of Forests. By using selective treatments rather than broadcast treatment, resource values, in addition to the primary purpose for managing vegetation, can be achieved in treatment areas.

(3) **Public Acceptance.** For the most part, the public is more receptive to proposed herbicide applications when the method of application involves ground rather than aerial equipment.

b. Technical Problems and Needs:

(1) **Technical Training and Technology Transfer.** Several years of non-activity in the aerial application field has resulted in a degradation, or least stagnation, of technical skills. Forests have not kept up with state-of-the-art methods of applying herbicides aerially, nor basic project planning and administration procedures.

Forests have benefited from work accomplished by R8, NEFES, and NCFES.

(2) **Evaluation Procedures.** Forests need to state-of-the-art methodologies for conducting pre- and post-treatment evaluations.

[illegible] evaluation pilot [illegible]
[illegible] aerial applic[illegible]
[illegible] application [illegible]
tion areas.

[illegible] will [illegible]
to the soil [illegible] method [illegible]
western Ohio [illegible]
s actually in the [illegible]
Deciding on appl[illegible]
[illegible]
well as prov[illegible]
s of aerial [illegible]

[illegible] in [illegible]
to address [illegible]

[illegible] herbicide-use is employed. Several [illegible] and some comments [illegible] discussed below.

Problems and Needs:

NSFA. The Region is [illegible]
current needs are in the [illegible]. The [illegible]
Office is developing a [illegible]

Benefits From Non Aerial Methods: [illegible] of using ground
[illegible] over aerial [illegible] protects [illegible] areas
outside of [illegible] Forests [illegible]
[illegible] rather than [illegible]
[illegible] the primary purpose for [illegible]
in treatment areas.

[illegible] For the most part, the public is more receptive [illegible]
applications when the method of application
[illegible] rather than aerial equipment.

[illegible] Technology Transfer: several years of
[illegible] tools [illegible]
[illegible] of technical skills [illegible] Forests have
[illegible] methods of applying herbicides
[illegible] and standardization [illegible]

[illegible] accomplished by R8 [illegible] and [illegible]

[illegible] to state-of-the-art methodological
[illegible] evaluation.

SUMMARY OF PESTICIDE-USE IN REGION 9, 1986-89

PESTICIDE	1986		1987		1988		1989	
	ACRES	LBS. AI	ACRES	LBS. AI	ACRES	LBS. AI	ACRES	LBS. AI
FUNGICIDES & FUMIGANTS	346 250 lbs. seed	4,003	197	2383	122	457	84	200
HERBICIDES & ALGICIDES	22,734	39,887	18,578	30,324	15,790	17,139	12,188	19,387
INSECTICIDES	419 29.7M BIUs	118	35,945 541.8M BIUs	15	8,928 142.2M BIUs	40	43,073 456.7M BIUs	625
PISCICIDES	2	5	3	5	0	0	0	0
REPELLANTS & RODENTICIDES	0 142 lbs. seed	2	0 80 lbs. seed	16	0 65 lbs. seed	0	0 50 lbs. seed	3
TOTAL USE	23,501 392 lbs. seed 3.5M BIUs	44,038	54,723 80 lbs. seed 541.8M BIUs	32,743	24,840 142.2M BIUs	24,643	55,345 50 lbs. seed 456.7M BIUs	20,215
HERBICIDE (major categories) 1/								
SITE PREPARATION	1,930	4,174	2,266	3,619	2,130	2,957	1,713	1,372
CONIFER RELEASE	11,851	12,393	7,589	10,376	6,957	9,457	4,599	5,331
RANGE MANAGEMENT & NOXIOUS WEEDS	1,161	552	629	457	944	603	1,112	836
WLD. HABITAT IMPROVEMENT	4,400	10,098	5,515	6,787	3,459	5,719	3,989	4,781
ROWS,ROADS & TRAILS	2,421	9,173	1,284	6,612	1,739	4,189	435	3,415
NURSERIES	24	43	68	212	32	138	18	3,340
SPITTLEBUG IPM	478	744	772	1,179	238	330	0	0

1/ Ground applications.

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SUMMARY OF PESTICIDE-USE IN REGION 9, 1989 [1]

ACRES TREATED BY FOREST

	ANF	CHF	CPF	GMF	HIF	HMF	MTF	MNF	NIF	OTF	SHF	SUF	WHF	WMF	TOTAL
FUNGICIDES & FUMIGANTS	0	0	0	0	0	0	0	2	0	82	0	0	0	0	84
HERBICIDES															
Aquatic Weeds [2]	0	0	0	0	0	0	7	4	0	0	0	0	0	0	11
Conifer Release	0	169	925	0	195	0	1838	0	989	416	0	0	67	0	4599
General Weed Control	0	0	0	0	2	0	0	6	212	0	0	0	0	0	220
Hardwood Release	0	0	0	0	0	0	61	0	0	0	0	0	0	0	61
Noxious Weeds	0	0	0	0	0	0	550	0	0	0	0	0	0	0	550
Nursery	0	0	0	0	0	0	0	0	0	18	0	0	0	0	18
Research	0	0	0	0	0	0	0	30	0	0	0	0	0	0	30
Range Management	0	0	0	0	0	0	442	0	0	0	0	0	120	0	562
Rights-of-Way	80	56	0	41	0	29	196	30	0	3	0	0	0	0	435
Site Preparation	1706	7	0	0	0	0	0	0	0	0	0	0	0	0	1713
Wildlife Improvements	0	394	49	0	0	0	3021	0	511	0	0	0	0	14	3989
SUBTOTAL HERBICIDES	1786	626	974	41	197	29	6115	70	1712	437	0	0	187	14	12188
INSECTICIDES [3] (G)	0	0	0	0	0	0	0	1	31	16	0	0	84	0	132
(A)	42170	0	0	0	0	0	0	771	0	0	0	0	0	0	42941
SUBTOTAL INSECTICIDES	42170	0	0	0	0	0	0	775	31	16	0	0	84	0	43073
RODENTICIDES & REPELLANTS (pounds of seed)	0	0	0	0	0	0	50	0	0	0	0	0	0	0	50
TOTAL ACRES TREATED	43956	626	974	41	197	29	6115	844	1743	535	0	0	271	14	55345
POUNDS OF SEED TREATED	0	0	0	0	0	0	50	0	0	0	0	0	0	0	50

[1] Compiled from FS 2100-1 forms.

[2] Includes algicides.

[3] A=Aerial applications.
G=Ground applications.

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HERBICIDE-USE IN REGION 9, 1986-89

	ACRES TREATED				
HERBICIDE	1986	1987	1988	1989	(lbs. A.I. in 1989)
AMITROLE	4	0	0	0	0
AMMONIUM SULFAMATE	414	530	525	32	112
ATRAZINE	80	45	140	313	314
ATRAZINE/GLYPHOSATE	0	20	0	0	0
BIFENOX	14	15	0	0	0
BROMACIL/DIURON	0	96	10	80	480
CACODYLIC ACID	8	0	0	0	0
COPPER TRIETHANOLAMINE	0	0	0	1	1
DALAPON	12	0	0	0	0
DACTHAL	0	2	0	0	0
DICAMBA	38	41	8	10	2
DICAMBA/2,4-D	0	2	3	0	0
DICHLOBENIL	1	0	0	0	0
DIQUAT	10	0	0	0	0
DIURON	90	0	1	24	24
DIURON/ATRAZINE	0	0	3	0	0
DIURON/OUST	0	0	0	1	2
ENDOTHALL	47	81	0	0	0
FOSAMINE AMMONIUM	12	362	426	136	2415
GLYPHOSATE	3241	2110	3706	2658	3656
GLYPHOSATE/ATRAZINE	0	0	25	0	0
GLYPHOSATE/OUST	216	220	21	442	473
GLYPHOSATE/SIMAZINE	1	0	0	0	0

HERBICIDE-USE IN REGION 9, 1986-89 continued

	ACRES TREATED				
HERBICIDE	1986	1987	1988	1989	(lbs. A.I. in 1989)
HEXAZINONE	7300	7430	4417	3289	4081
HEXAZINONE/OUST	0	2	0	0	0
IMAZPYR	0	4	10	10	10
LINURON	15	0	0	0	0
MCPA	85	0	0	85	170
MEFLUIDIDE	1	0	0	0	0
MEFLUIDIDE/DICAMBA	24	0	0	0	0
METOLACHLOR	15	0	0	0	0
MINERAL SPIRITS	0	0	0	7	3320
NAPROPAMIDE	0	35	0	3	14
OUST	1082	511	425	512	73
OXYFLUORFEN	4	6	0	3	2
PICLORAM	1782	733	475	293	105
PICLORAM/FOSAMINE AMMONIUM	0	7	12	0	0
PICLORAM/2,4-D	3817	2629	2454	1599	770
PICLORAM/2,4-D/ TRICLOPYR	323	334	514	0	0
PICLORAM/2,4-DP/ TRICLOPYR	40	0	0	0	0
SIMAZINE	18	9	13	4	8
SETHOXYDIN	0	10	0	3	1
TEBUTHIURON	244	492	729	677	510
TRICLOPYR	1522	1347	765	1209	996
TRICLOPYR/2,4-D	10	10	29	5	15
TRICLOPYR/PICLORAM	0	185	0	45	205
2,4-D	1309	943	1114	609	1507

HERBICIDE-USE IN REGION 9, 1986-89 continued

HERBICIDE	ACRES TREATED 1986	1987	1988	1989	(lbs. A.I. in 1989)
2,4-D/2,4-DP	574	123	30	32	40
2,4-D/2,4-DP/DICAMBA	18	5	100	106	81
2,4-D/2,4-DP/TRICLOPYR	182	133	0	0	0
2,4-DP	0	0	25	0	0

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APPENDIX C

Scientific and Technical Exchange
between
the United States and the People's Republic of China
on
Forest Vegetation Management and Herbicide Science

April - May 1989

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EXECUTIVE SUMMARY

The objective of the technical exchange was a two-way sharing of information on forest vegetation management practices and the uses of herbicides in forestry, including application technology. Central to the exchange were two seminars: a national-scope seminar held at the Southwest Forestry College in Kunming, Yunnan Province, and a regional-scope seminar held at Nanjing Forestry University in Nanjing, Jiangsu Province. Miller and his interpreter, Professor Qiu Zhongzu, delivered a total of 55 hours lecture at the two seminars.

Information on China was gained through site visits and tours of forested areas, research institutes, and universities, along with presentations by researchers attending the seminars. The seminar outline is given in Appendix 1 and the trip itinerary in Appendix 2.

The major results and observations of the exchange are:

> **China continues to harvest more forests than are being successfully established.** Reforestation has only been successful on about 17% of the lands planted during the last 40 years. In the southern forest region, firewood harvesting and over grazing by villages are stymieing most afforestation and reforestation efforts. Yunnan Province was 33% forested in 1957 and was only 12% forested in 1984.
>
> **Herbicides are increasingly being used in forestry for maintenance of firebreaks, weeding tree nurseries, and plantation establishment of fast-growing species.** As in the U.S., proper usage is being learned through trial-and-error applications by user groups and through some excellent but meager research by a handful of scientists. Many researchers in the area of plant protection are eager to learn about herbicides and application techniques--many attended the seminars. The economics of all the research presented at the seminars shows that herbicide applications are 3 to 10 times cheaper than hand labor for all uses. Most uses are for herbaceous weed control while woody plant control is foreign to China because of the high utilization of fuelwood.

There is interest to publish a translation of "A manual on ground applications of forestry herbicide - edited by Miller and Mitchell" in China, to aid development and to guide proper application procedures. A preliminary translation was presented to seminar participants. A formal publication will probably require cooperative financial assistance.

The chinese have developed application techniques using wicks and wipers which should have promise in the U.S. to decrease herbicide costs.

Cooperative contacts were made at both Southwest Forestry College and Nanjing Forestry University to assist in identifying biological control agents for kudzu, a native species of China. If established, these cooperative efforts should result in considerable cost savings for the biological control program just getting started in the southern U.S. China has been involved with biological control of imported weeds for over 10 years and are well versed in this area.

Many valuable examples were seen on growing shrub crops between tree rows to minimize competition and for gaining early cash returns for the farmer. These practices need to be explored in the South.

On a global perspective, air and water pollution goes unabated in China, causing increasing environmental deterioration. Contributions of atmospheric agents and elimination of mitigating influences that control global warming are obvious in China.

China is in need of more technical exchange visits from forestry scientists and managers to assist them in their massive reforestation effort. Much research is needed in all aspects of regeneration, especially on mountainous sites. Managers could assist in organizing their resources to be successful in these efforts. The visits need to be for extended time periods in order to assure that projects get started adequately. Without this in-country assistance it is difficult to see a desperate situation of declining wood supplies, turning around.